mental challenge. The one just discussed is an example; others might easily be cited, for instance the reasoning leading to the conclusion that prominences are not of the chromosphere and must, therefore, come from the outside. But space forbids further discussion in this direction.

The training of the volunteer corps of H. M. S. 'Volage' was ingeniously planned and carried out with pains. Parties consisting of those fitted for certain classes of work were organized and regularly drilled for some time preceding the eclipse. In training the sketchers, former coronas were thrown on a screen by means of a magic-lantern and, after some practice, remarkable proficiency was shown in accurately drawing the objects, within the eclipse interval of time. It is doubtful, however, whether results of value are to be had from drawings of the corona. Since such very short exposures are required completely to fog a photographic plate the question of getting faint outlying details is merely one of contrast, and with skillful exposure and development there seems to be no reason why the camera should not be considered superior to the sketch-book in delineating eclipse phenomena, as it has shown itself to be in innumerable other branches of research.

With regard to the bearing of solar work in general on dissociation, it is safe to say that the consensus of scientific opinion is not with Sir Norman Lockyer. While dissociation is admitted as a possibility, it is not considered that a preponderence of evidence has given it the standing of a scientific fact. It is claimed that for astrophysics there is laid the foundations of an exact science. But as yet the superstructure has not neared completion. Peculiar characteristics of spectra accompany certain physical conditions. Good work has been done in the direction of associating the one with the other, but it is only a beginning. It is doubtful whether most scientists consider that the influence of all our terrestrial conditions upon the spectrum has been determined, or even guessed, to say nothing of those which may exist in the sun and stars. In time to come, when knowledge becomes more definite on some of these points, and the effect of influences probably existing in the sun has been allowed for, we may, with a mental reservation, assign the residual anomalies of solar and stellar spectra to some condition which we suspect to exist. Until then this line of attack is to be followed with caution.

"In the course of the spectroscopic solar investigations which have been going on since 1868 I have had to point out over and over again that the phenomena observed could be more easily explained on the hypothesis that the chemical elements with which we are familiar here were broken up by the great heat of the sun into simpler forms" etc. In the present state of our knowledge it is somewhat of a problem how much of a figure the question of 'ease' should cut. We call to mind the fact that, on account of insufficient experimental data, the phenomena of light were more *easily* explained to Newton by the emission hypothesis than by the wave theory. And we are not all Newtons.

In closing, however, it is to be said that Sir Norman Lockyer has given us an interesting book, one particularly so to the general public. Technical subjects are explained in simple language, and the mere recital of facts and theories has been relieved from time to time by digressions upon subjects of a more human nature. This is particularly so in the account of the 1896 eclipse expedition. It is hoped that the volume will give to amateurs and others who may witness the coming eclipse such a knowledge of some of the problems awaiting solutions as will enable them to make intelligent observations which may be of interest to themselves and of use to science.

W. H. Wright.

Lick Observatory, December, 1897.

RECENT MATHEMATICAL BOOKS.

Famous Problems of Elementary Geometry. An authorized translation of F. Klein's 'Vorträge über ausgewählte Fragen der Elementargeometrie.' By Wooster Woodruff Beman, Professor of Mathematics in the University of Michigan, and David Eugene Smith, Professor of Mathematics in the Michigan State Normal College. Boston, Ginn & Co. 12mo. Pp. ix+80.

Augustus De Morgan, who in his day waged such merry war with the circle squarers, got half the delight of battle from the fact that he had to meet his foes in single combat and pepper them with small shot, a kind of warfare from which he was sure to emerge with joyous triumph and an appetite for more. To chase his prey through a tangle of reasoning had to his versatile mind the zest of a fox hunt. To kill all the foxes at one discharge would have spoiled his sport. Until very recently the circle squarer had one safe retreat. Nobody could logically dispose his general thesis. And, beside, he had philosophic and scriptural authority. A circle is a perfect figure. That which is one span across is three spans around. Even the august Legislature of Indiana was lately beguiled by a *savant* from Hooppole county into enacting that no circle should be *de rigeur* in that State for which the ratio of circumference to diameter was not exactly three and two-tenths. But we have changed all that. The circle squaring fraternity has long had no standing in court, but now a perpetual injunction is out against them. Not only do we now possess a proof of the transcendental nature of the number π, but this proof has been recently so simplified as to be perfectly intelligible at a very early stage of mathematical study.

The mathematical *pi* is inedible without *e*. The modern investigations begin with Hermite's proof of the transcendence of the exponential base in his paper '*Sur la fonction exponentielle*,' *Comptes Rendus*, 1873. Lindemann's celebrated proof of the transcendence of π appeared in the *Mathematische Annalen*, 1882. The connecting step is the establishment of the theorem that in an equation $c_0 + c_1 e^k + c_2 e^l + \cdots = 0$, the exponents and the coefficients cannot all be algebraic numbers. From Euler's equation $1 + e^{\pi i} = 0$, the transcendental character of π then follows at once. But it was first in 1893 that Hilbert, Hurwitz and Gordan did away with the earlier formidable apparatus and reduced the proof to the present elementary form. The results, together with the modern disposition of the kindred problems of the duplication of the cube and the trisection of an arbitrary angle, have since been made generally available by the publication in book form of Klein's lectures on these subjects. These lectures have already been translated into French and Italian, and we have now, thanks to Professors Beman and Smith, an excellent English version. The present book is well edited and well printed. Every teacher of even elementary mathematics will do well to obtain a copy, not merely for his library, but to be actually read.

The Calculus for Engineers. By JOHN PERRY, Professor of Mechanics and Mathematics in the Royal College of Science, London. London and New York, Edward Arnold. 8vo. Pp. viii+378.

From the title of this book one might naturally expect to find in it a considerable deviation from the prevalent stereotyped treatment of what the author rather deprecatingly calls 'academic' calculus. On inspection, however, the divergence turns out to be about as complete as could well be imagined. The author's aim is to make the methods of the calculus available for the use of students who already have a considerable knowledge of practical physics and mechanics. A great deal can be done in this direction by the aid of a few functions and the simplest rules of differentiation and integration. In the present book the first 266 pages are divided into two chapters, one of which deals, so far as the calculus proper is concerned, with x^n, the other with e^x and sin x. These chapters are filled with an excellent collection of examples drawn from every branch of applied mathematics. To give an idea of the diversity in this regard, I cannot do better than to quote from the index, which is in itself a commendable feature of the book. Under B, which supplies one of the shortest lists in the index, we have: Ballistic effects; Basin, water in; Beams, fixed at ends, of uniform strength, shear stress in, standard cases; Beats in music; Belt, slipping of; Bending, in struts; Bessels; Bifilar suspension; Binomial theorum; Boiler, heating surface of; Bramwell's valve gear; Bridge, suspension. Very many of the examples are of a kind to be very appropriately introduced into the 'academic' books; and considering how completely latter-day writers on

the calculus have plucked Williamson and Todhunter and each other, I recommend a raid on Perry by way of refreshing variety.

Having got his reader fairly into the calculus, the author finally confesses a weakness for the subject and adds a third chapter of 'academic exercises,' in which he treats the subject of the usual text-books, only in a different order and briefly, but nevertheless including differential equations, Bessel's functions and spherical harmonics.

Even the student who has already studied the calculus in the usual systematic form will profit by traversing it with the author; and to the engineer the book must be very useful. The lecture style in which it is written often makes the subject more attractive. It also sometimes carries away the author, in an excess of enthusiasm, into expressions of opinion which are not to be taken too seriously nor yet to be 'skipped,' as the author advises in the cases of difficult passages.

F. N. Cole.

Columbia University.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, NOVEMBER, 1897.

A New Human Tænia (Tænia confusa, Ward). —The new form has much of the slender appearance and delicate structure of *Tænia solium*, but as regards the size of the proglottids is even larger than *Tænia saginata*. The segments are of almost uniform breadth and very narrow. In addition to a peculiarly constructed head, the worm presents many variations of bodily structure when compared with the ordinary forms. The sexually mature proglottids measure 4–5 mm. long by 3–4.5 mm. wide; the lobes of the ovary are kidney-shaped and two or three times as long as broad; the genital pore is extremely shallow; in all of which respects it differs markedly from either *T. saginata* or *T. solium*. A short distance from the exterior the vagina is provided with a very distinct sphincter muscle. A similar structure was found also in preparations of *T. saginata*. Such a muscle, heretofore, was thought to exist only in other than human Tæniæ. Just before the vagina reaches the receptaculum seminis it becomes highly modified and, unlike that of *T saginata* or *T. solium*, is encircled by a number of small sphincter muscles. As regards the male reproductive system, the testes are smaller than those of *T. saginata*, and a distinct seminal vesicle is present. The terminal or ripe proglottids are of an extreme length, measuring 28–35 mm. long by only 4–5 mm. wide. They never have the peculiar pumpkin-seed shape so characteristic of *T. saginata*, but are of constant transverse diameter, flaring slightly at the posterior end to form a broad base of attachment for the succeeding proglottid. The branches of the uterus number from 11 to 14, and are divided more or less arborescently, resembling those of *T. solium* somewhat in general configuration. The eggs are without pyriform apparatus and measure about 30 by 39 micra. The longitudinal nerves run in strands of from three to five down each side of the body; near the pore the strands separate, part going ventral and part dorsal to the genital ducts. The longitudinal muscles are continuous throughout the body.

M. F. Guyer.

Some Features of the Oögenesis of Sternaspis. —The egg-cells arise in the manner described by Vejdovsky from the peritoneal epithelium of certain blood-vessels, forming a single pair of distinct ovaries, each surrounded by a fold of the peritoneum and opening to the exterior of a distinct oviduct.

As the egg-cell grows a pedicle is formed beneath it, and in this appears a loop of the blood-vessel as described by Vejdovsky. The end of the loop enters the egg-cell.

In early stages the egg-cell contains a large nucleus with prominent nucleolus and reticular cytoplasm. As growth proceeds the cytoplasm begins to assume a radiating structure, centering about the end of the vascular loop. The first yolk-granules deposited appear in the portions of the egg farthest from the point of attachment. The radiate arrangement of the cytoplasm becomes more distinct as yolk is formed, and the region immediately surrounding the vascular loop stains very deeply.

The egg is now pear-shaped, hanging from its stalk with the nucleus in the broader end sur-